

The Injury Pattern of a New Law Enforcement Weapon: The Police Bean Bag

From the Department of Emergency Medicine, Los Angeles County+ University of Southern California Medical Center,* and the Keck School of Medicine, University of Southern California,† Los Angeles, CA.

Author contributions are provided at the end of the article.

Received for publication October 13, 2000. Revisions received February 6, 2001, and April 2, 2001. Accepted for publication May 1, 2001.

Presented at the International Association of Forensic Sciences Fifteenth triennial meeting, Los Angeles, CA, August 1999, and the Society for Academic Emergency Medicine Western Regional Research Forum, Portland, OR, April 2000.

Address for reprints: Dirk de Brito, MD, MPH, King's Daughters Hospital, 2201 Lexington Avenue, Ashland, KY 41101; E-mail debrito2@earthlink.net.

Copyright © 2001 by the American College of Emergency Physicians.

0196-0644/2001/\$35.00 + 0

47/1/117272

doi:10.1067/mem.2001.117272

Dirk de Brito, MD, MPH*
Kathryn R. Challoner, MD*
Ashish Sehgal, MD*
William Mallon, MD†

Study objective: This case series describes the injury pattern of the police bean bag, a new weapon adopted by US law enforcement agencies.

Methods: Retrospective chart review between 1996 and 2000 identified bean bag injuries. Autopsy data were gathered for 1 fatality. Circumstances of the shootings, toxicology results, and psychiatric diagnoses, if any, were recorded.

Results: Thirty-nine men and 1 woman between the ages of 16 and 77 years were shot by officers of either the Los Angeles Police Department or the Los Angeles Sheriff's Department. The fatality was caused by massive hemothorax after thoracic penetration. The locations of serious penetrating injuries included the thoracic cavity, eye, abdomen, arm, and leg. Blunt injuries included splenic rupture, pneumothorax, compartment syndrome, testicular fracture, subcapsular liver hematoma, and cardiac contusion. Complications included hemothorax, pneumopericardium, wound infection, compartment syndrome, and osteomyelitis. Psychiatric consultation was requested for 27 (69.2%) of 39 surviving patients. The *Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV)* Axis I was used for diagnosis in all 27 patients. Psychosis was diagnosed in 16 (59.3%), suicidal ideation in 15 (55.6%), and major depression in 6 (22.2%) of the 27 cases. Schizophrenia had previously been diagnosed in 7 (25.9%) of the 27 cases. All but 1 of the patients had toxicology screenings performed, and the results of 29 (74.4%) of 39 were positive. Of these 29 positive results, 15 (51.7%) were positive for alcohol and 8 (27.6%) were positive for cocaine.

Conclusion: Awareness of the broad scope of potential injuries mandates a thorough evaluation of both blunt and penetrating trauma in patients shot with police bean bags. The scope of these injuries raises significant public health considerations because use of this weapon has been adopted by law enforcement agencies in all 50 states and at least 10 countries.

[de Brito D, Challoner KR, Sehgal A, Mallon W. The injury pattern of a new law enforcement weapon: the police bean bag. *Ann Emerg Med.* October 2001;38:383-390.]

INTRODUCTION

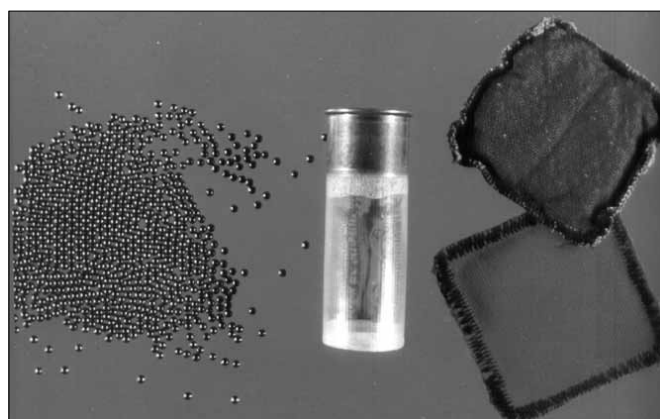
The use of force by police officers has undergone increased scrutiny in both the legal community and the public arena.¹ This has heightened the need for “nonlethal” or, more accurately, “less lethal” weapons to control combative suspects. The police bean bag is the latest alternative to deadly force. The police bean bag is a synthetic bag filled with lead pellets and is fired from a shotgun (Figure 1). Although it was first developed in the early 1970s, it has only been in use in the United States since 1994. In the 1970s, the US Army used mathematic models and anthropomorphic dummies to investigate the weapon’s morbidity and mortality.² In the investigation, it was theorized that the liver and spleen would be vulnerable to the weapon if impacts occurred directly over them. To date, descriptions of human injury have been limited to 1 case in the medical literature.³ In this study, 40 new cases of injury caused by the police bean bag are presented, including the first fatality to be described in the medical literature.

MATERIALS AND METHODS

The case series was primarily identified through a retrospective review of charts of the Los Angeles County+University of Southern California (LAC+USC) Hospital. To be included, a chart had to involve an injury that occurred as a direct result of the use of the bean bag weapon.

Figure 1.

Police bean bag (The Flexible Baton MK-12).



The 40 incidents in this study occurred between January 1996 and February 2000. The medical liaison worker who reviewed all jail ward charts identified those involving bean bag injuries. The fatality, in which the patient died in the field, was identified by personnel in the coroner’s office who were aware of the ongoing study. Details were obtained through the coroner’s autopsy report and police reports. When possible, police officers were interviewed and asked to estimate the firing range to the suspect. In all cases, subjects involved in the study were shot by members of the Los Angeles Police Department or the Los Angeles Sheriff’s Department. Injuries were categorized both anatomically and by mechanism (blunt vs penetrating). Toxicologic studies were reviewed. Psychiatric evaluations, if performed, were reviewed, including global assessment of functioning (GAF) scores.⁴ This study was approved by the institutional review board.

RESULTS

The age range of the patients in this series was 16 to 77 years (mean 32 years); 39 of 40 patients were men. All patients initially presented for medical care in the custody of law enforcement personnel, and most had been shot

Table 1.

Injuries caused by 99 bean bag rounds.

Injury	No. of Rounds Causing Injury
Contusions, hematomas, or abrasions without additional pathologic lesions	69
Lacerations without retained bean bag	8
Closed fractures	6
Penetrating wounds with retained bean bags	7
Nonfatal thoracoabdominal penetrations	3
Facial lacerations	3
Compartment syndromes	2
Facial fractures	2
Fatal hemothorax	1
Splenic rupture	1
Pneumothorax	1
Cardiac contusion with pneumopericardium	1
Testicular fracture	1
Subcapsular splenic hematoma	1
Ocular globe rupture	1
Orbital fracture	1
Subcapsular renal hematoma	1
Rhabdomyolysis	1
Partial thumb amputation	1
Laceration with resultant osteomyelitis	1
Wound infection	1

more than once. The average number of hits per patient was 2.48 (range 1 to 12 hits).

Table 1 provides an injury list and the number of rounds causing each type of injury. The body impact map (Figure 2) shows the anatomic distribution of bean bag hits.

Suicidal ideation was documented in 15 (37.5%) of 40 patients (Table 2). Psychiatric consultation was requested in 27 (69.2%) of 39 cases, and the *Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV)* Axis I diagnoses were made in all of these cases.⁵ Psychosis was diagnosed in 16 (59.3%) of 27 evaluated patients. Schizophrenia was previously diagnosed in 7 (25.9%) of 27 patients. Depression was diagnosed in 6 (22.2%) of 27 patients. Manic bipolar disorder was diagnosed in 3 additional patients. The GAF scores averaged 27.3 (range 10 to 50), which indicates serious impairment with an inability to function in almost all areas.

On presentation, altered mental status or Glasgow Coma Scale (GCS) score less than 15 was identified for 26 (66.7%) of 39 patients; however, no patient had an initial

GCS score of less than 14. Toxicology screenings were performed on all but 1 of the patients, and the findings of 29 (74.4%) of 39 screens were positive. Of these 29 screens, the findings of 15 (51.7%) of 29 were positive for alcohol and 8 (27.6%) of 29 were positive for cocaine. The findings of 3 (10.3%) of 29 screens were positive for tricyclic antidepressants.

Selected case vignettes

Case 1. Two police officers responded to a call regarding a man causing a disturbance. The man reportedly threw

Figure 2.
Body impact map.

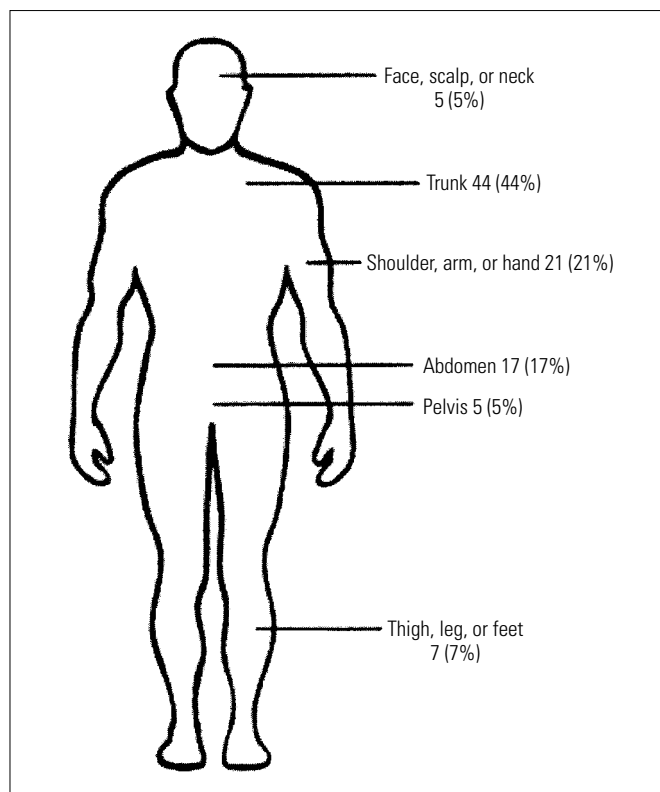


Table 2.

Psychiatric diagnosis and GAF score in patients given psychiatric evaluation.

Patient No.	Axis I Diagnosis	Axis II Diagnosis	GAF Score
2	Substance-induced psychosis, rule out schizophrenia	Deferred	20
3	Substance-induced mood disorder, bipolar manic	Antisocial personality disorder traits	55
4	Psychosis NOS, ruled out schizophrenia	Mental retardation, unspecified	15
5	Depression NOS, ruled out major depression	Deferred	25
6	Substance-induced psychosis	Deferred	15
7	Psychosis NOS	Deferred	30
8	Schizophrenia	Deferred	40
9	Substance-induced depression	Deferred	30
11	Ruled out anxiety disorder	Deferred	45
12	Bipolar manic	Antisocial personality disorder traits	30
13	Psychosis NOS	Deferred	50
15	Substance-induced psychosis with history of schizophrenia	Deferred	20
16	Schizophrenia	Deferred	35
19	Psychosis NOS, ruled out schizoaffective	Deferred	10
21	Bipolar manic	Antisocial personality disorder	30
23	Alcohol-induced psychosis	Borderline personality disorder traits	25
28	Schizophrenia, paranoid	Deferred	30
30	Major depression	Deferred	10
31	Schizophrenia	Deferred	25
32	Substance-induced depression	Borderline personality disorder traits	40
33	Depression NOS	Deferred	20
34	Substance-induced psychosis	Deferred	21
35	Depression with psychotic features	Deferred	25
36	Substance-induced mood disorder	Deferred	35
37	Psychosis NOS	Antisocial personality disorder	20
38	Psychosis NOS	Deferred	20
39	Cocaine-induced psychosis	Deferred	15

NOS, Not otherwise specified.

rocks at the officers and advanced, carrying a piece of metal he had picked up from the ground. The first officer fired 2 rounds of bean bags; both rounds missed the suspect. The second officer then shot 2 more rounds from a range that the officer estimated at 8 m (25 ft), striking the man in the chest and jaw. Responding paramedics pronounced the man dead 15 minutes later.

At the autopsy, 2 penetrating wounds were revealed. A bean bag had entered the chest to the right of the midline, just above the nipple; the wound caused a massive right-sided hemothorax with 1,150 mL of blood in the chest. The round had apparently first struck a metal medallion that the man wore on his chest. This medallion and the bean bag were both removed intact from his chest cavity at the autopsy. The bag had tracked through the second intercostal space and lacerated the right upper and middle lobes of the lung. The second round, which hit the man in the jaw, had created a penetrating wound through the cheek. This bean bag round was embedded, still in a folded configuration together with its wadding, against the fractured left mandible.

Case 2. A 45-year-old man waving a gun confronted police. After what the patient described as a 2-week crack binge, he was psychotic, paranoid, and claiming to be suicidal. He charged responding officers who fired, striking his right chest with a bean bag round. On presentation to the emergency department, he was tachycardiac and normotensive, with an oxygen saturation of 96% on room air. Physical examination was significant for a 4-cm chest lac-

eration just below the right nipple in the midclavicular line and decreased breath sounds in the right lung. A chest tube yielded 200 mL of blood. Chest computed tomography (CT) revealed a large pulmonary contusion with a bean bag embedded in the right posterior chest cavity (Figure 3). During surgery, the bean bag was found to have ruptured. Approximately 100 pieces of No. 9 lead shot were removed from the pleural cavity.

Case 5. A suicidal 18-year-old man wielded a machete during a family conflict. The man advanced on sheriff's deputies; their report stated that he "attempted to force deputies to kill him." Deputies shot the man with 2 bean bags. The patient was examined first at one hospital but was transferred to LAC+USC with a diagnosis of a possible ruptured globe. Further evaluation in the LAC+USC ED revealed that both the bean bag and its casing were embedded in the remains of the patient's right eye (Figures 4 and 5). A complex blowout fracture of the right orbit was present with zygomatic and inferior floor disruption. Superior and inferior eyelid tissues were evulsed with loss of tissue. Enucleation was completed at surgery.

Case 10. A combative 32-year-old man with altered mental status resisted apprehension and was shot with a bean bag round that struck him in the left upper quadrant. The patient informed physicians that he was schizophrenic and denied abdominal pain. Two hours after his initial

Figure 3.

Chest CT scan of case 2.

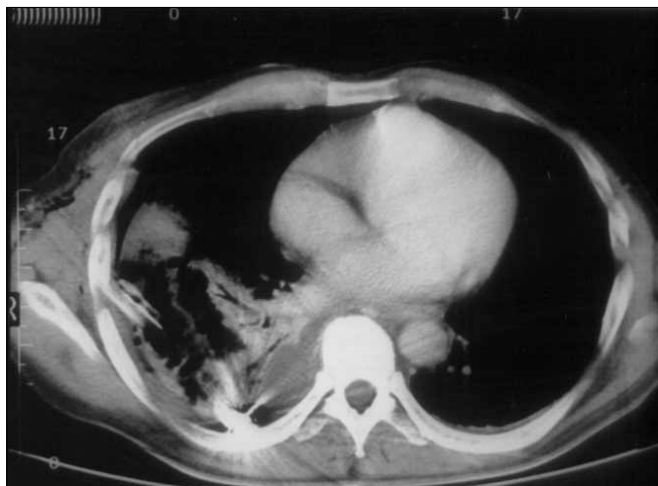
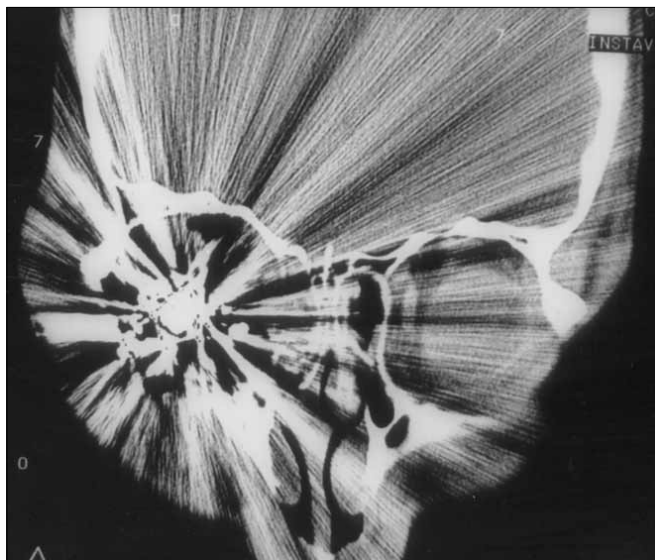


Figure 4.

Facial CT scan showing intraorbital bean bag in case 5.



evaluation, the patient became lethargic and tachycardiac. The patient was intubated and a head CT scan was performed, the results of which were negative. The emergency physician performed an abdominal ultrasonographic scan that demonstrated free fluid. The patient underwent emergency splenectomy for a grade 4 splenic rupture.

Case 11. A 37-year-old knife-wielding man dared police to shoot him. He advanced toward police and was shot from a range that they verbally estimated at 10 ft (3 m). The patient's forearm was assessed to have an abrasion with soft compartments (Figure 6). Two hours later, the patient's forearm was increasingly firm and painful. Compartment pressures of 70 mm Hg were obtained with the Stryker device (Stryker Corporation, Portage, MI) in the dorsal forearm.⁶ A fasciotomy released a tense compartment with a 5-cm area of myonecrosis at the bean bag impact point (Figure 7).

Case 13. A naked 23-year-old man threatened responding police officers with an axe. He was sprayed with oleo-

resin capsicum and struck in the chest with 3 bean bag rounds, 2 of which struck the left precordium. At evaluation, an ECG demonstrated elevated ST segments in anterior leads. Troponin I levels were initially elevated at 2.3 ng/mL and decreased thereafter. An echocardiogram demonstrated pneumopericardium and mild left ventricular dysfunction consistent with myocardial contusion.

Case 14. A 32-year-old man threatened responding police officers with a machete. He was shot with bean bags that struck his right upper quadrant and his genitals. Officers approximated the shooting range to have been 10 ft. A CT scan revealed a subcapsular hematoma of the left lobe of the liver and extravasation of contrast within the scrotum. A fractured and hemorrhaged right testicle was removed during surgery.

Figure 5.

Intraoperative orbit with bag and shell casing inside in case 5.



Figure 6.

Forearm abrasion of case 11.



Figure 7.

Same forearm as in Figure 6, at fasciotomy of case 11.



DISCUSSION

Law enforcement agencies in all 50 states and 10 countries have been granted approval for the use of the police bean bag.⁷ Increasing distribution makes it likely that greater numbers of emergency physicians will encounter bean bag injuries. The previous 5 years of police bean bag use by US law enforcement agencies, specifically in the city of Los Angeles, represent the only clinical data available for this weapon.

Our review clearly involves a degree of spectrum bias, and these injuries are likely to constitute the more severe examples of the weapon's effects. Presumably, because LAC+USC Hospital is the only site for incarcerated inpatient care in the county, few injuries occurring within Los Angeles County and requiring inpatient stay were missed. However, because not all of the records from surrounding hospitals or all police and coroner records were reviewed, it is possible that this study underestimates both serious bean bag injuries and the number of fatal injuries. Both the Los Angeles Police Department and the Los Angeles Sheriff's Department have official policies that mandate medical evaluation after bean bag impacts. In most cases, that evaluation would occur at the LAC+USC jail ward.

Three companies manufacture the police bean bags used in the United States. Each company produces similar bean bags. The best-selling police bean bag, the Flexible Baton-12 Standard (Figure 1), is sold by MK Ballistic Systems (Hollister, CA) for use in law enforcement, corrections facilities, and riot control. They acknowledge that the weapon "can cause bruises, skin abrasions, and other injuries..."⁸ The shell fires a red fabric bag filled with 40 g of No. 9 lead shot and has a projectile velocity of approximately 90 m/s and a kinetic energy of 160 J at the muzzle. The recommended range is 10 to 30 m.⁹ A "close-range" round with a projectile velocity of 70 m/s is also available with a recommended range of 3 to 15 m. This "close-range" round is not used by either the Los Angeles Police Department or the Los Angeles Sheriff's Department.

The bag is designed to exit the shell, separate from the synthetic wadding, and unfold so that the largest surface area of the bag, approximately 26 cm², is perpendicular to the impact vector. The bag is intended to collapse on impact to distribute the kinetic energy over this large surface. The impact can be compared with that of a common baseball. The bag has kinetic energy at a range of 30 ft (9 m) that is nearly double that of a major league fastball (Flexible Baton: 0.04 kg, velocity 70 m/s, kinetic energy 98 J; fastball: 0.14 kg, velocity 27 m/s, kinetic energy 51 J).

It is clear that the bean bag has not always performed as the design intended. Although the bag is made with a resistant synthetic cloth and is not intended to break, the bags can tear and release the pellets. Both the pellets and the entire bag have caused penetrating injuries. In one instance, the bag did not separate from its shell, resulting in its penetration into the patient with the bean bag still encased. In the fatal case, the second wound contained a still-folded bag complete with its wadding, which did not separate before impact. Despite these observations, the overall incidence of serious injuries cannot be accurately determined because the series did not include subjects who were fired at but who did not sustain injuries.

Although the possibility of internal organ injury from the bean bag weapon was previously hypothesized, a more impressive spectrum of injury has been demonstrated than was hypothesized. It appears that no area of the body is immune from injury. These injuries were perhaps best predicted 20 years ago when the US Army investigated the possible morbidity and mortality of the bean bag weapon using mathematic models, animal testing, and anthropomorphic dummy testing at the Aberdeen Proving Grounds. This 1974 study concluded that "medical evaluations... indicat[e] that stun-bag impacts tend to cause internal organ damages"; the study continued, explaining that "Test shot data... indicate a considerably higher probability of undesirable effects than of desirable effects."² More than 2 decades later, a contribution to the 1996 Asia Pacific Police Technology conference concluded that bean bag technology was an "unacceptable" method of nonlethal incapacitation.¹⁰

These concerns may have been overlooked because of the great potential of the bean bag as an alternative to deadly force. Both suspects and law enforcement agencies can benefit from nonlethal technologies. Despite the injuries documented here, bean bags clearly cause fewer injuries and deaths than bullets.

A pattern of underestimation of injury by the emergency physician emerges from this series of patients. For emergency physicians, the population of intoxicated patients, psychiatrically ill patients, and those with altered mental status who have sustained bean bag injuries is difficult to assess for abdominal tenderness on examination. Ten patients (cases 3, 7, 10, 16, 18, 19, 26, 29, 33, and 34) all experienced at least 1 bean bag impact to the abdomen, with mild to moderate tenderness on examination. All of these patients were noted by the emergency physician as having altered mental status, which rendered a difficult abdominal examination even less reliable. However, in each of these cases, an abdominal CT scan was not

ordered during the patient's stay in the ED and a consultation was not requested from the trauma surgeons. Although emergency physicians routinely perform ultrasonography for other types of blunt abdominal trauma, bedside ultrasonography was performed in only 4 of these 9 cases. In case 10, the patient underwent head CT scanning because of concern that the patient may have sustained head trauma as he was taken into custody. The emergency physician, who was unaware of the potential morbidity of the bean bag impact, believed that it was more important to investigate undemonstrated head trauma than the known bean bag strike to the abdomen. This strike had ruptured the patient's spleen. Similarly, the thoracic penetration in case 2 was entirely unexpected when discovered; the chest radiograph had been ordered to assess the possibility of pneumothorax. Penetration of both the round and its casing into the patient's orbit (case 5) was both unexpected and undetected by the initial receiving hospital.

Even in the more benign cases (cases 15 to 40), the degree of suicidal ideation, mental status alteration, and drug or alcohol toxicity create numerous medical and psychiatric comorbidities. On initial ED evaluation, this more benign group of patients may be indistinguishable from those patients who were more seriously injured. Given these patients' examination confounders, these patients required nearly the same workup as if they had been comatose trauma victims. Most of these patients had a GCS score of 14, which gave false reassurance regarding the physician's examination and its reliability.

The exact distances from which the bean bags were fired in the field are unknown. It is likely that distances less than those recommended by the manufacturer were frequently used, as suggested by cases 3, 11, and 14 (2 upper extremity penetrations, compartment syndrome, and liver and testicular injuries, respectively). In these cases, police officers verbally estimated the firing range to be 8, 10, and 10 ft (2.4, 3, and 3 m), respectively. In only a few cases were police officers available and willing to provide range estimates. This is almost certainly because these ranges are at odds with their department's official policy. For example, a 1996 Los Angeles Police Department memo titled "Protocols and Procedures for Bean Bag Shotgun Deployment" mandated "the minimum deployment range for the Bean Bag round is 10 yards [9.1 meters] and the maximum effective range for accuracy purposes is 15 yards [13.7 meters]."¹¹

However, field realities complicate such efforts to reduce bean bag injuries. Rounds were fired at suspects who actively charged police officers, making it difficult to limit

the firing range to more than 9 m. Deployment is often indoors in the crowded urban environment. Outdoor deployment, especially in the setting of a riot, can be further complicated because persons who have been struck by the weapon may never be apprehended in the ongoing disturbance and thus may never be taken for medical evaluation.

Injury prevention by decreasing the round's propellant charge would be likely to fail. A lack of true incapacitation was confirmed in the cases presented here, with patients struck by as many as 6, 8, or 12 bean bag rounds in addition to being hit by Taser darts (Taser International, Scottsdale, AZ) and oleoresin capsicum spray. This suggests that the weapon will become useless before it becomes completely safe. The body impact map (Figure 2) provides evidence that aiming the weapon toward or away from any body areas would likely have little success; law enforcement officers are already taught to aim for center mass, yet the impacts are clearly widely scattered. Moreover, the injury list shows that impacts can cause significant damage anywhere on the body.

All patients in whom psychiatric consultation was obtained had a formal Axis I disorder diagnosed. It is unknown how many of the other 12 (31%) patients would have had significant psychiatric diagnoses. The average GAF score of 27 places these patients in a GAF group (21 to 30) that the *DSM-IV* describes as follows: "Behavior is considerably influenced by delusions or hallucinations or serious impairment in communication or judgement with inability to function in almost all areas."⁴ Thus, the 69% of the patients who had the benefit of psychiatric evaluation had sufficiently impaired communication, judgment, or both so that they would be unlikely to be able to comply with an arresting officer's instructions to submit. Furthermore, their "inability to function in almost all areas" would seem to directly identify these patients, at least at the time of their assessment, as being in need of inpatient psychiatric care. The worldwide trend toward closure of inpatient psychiatric facilities and increased outpatient care of psychiatric illnesses will thus only serve to increase the number of potential bean bag targets.

These injuries raise serious public health considerations because the weapon is used throughout the United States and in an increasing number of foreign countries each year. This case series and the diverse injury pattern presented may stimulate public health discussion regarding the use of the police bean bag both in the United States and abroad. Emergency physicians worldwide should consider both the blunt and penetrating injury patterns of the weapon with their significant potential morbidity.

This series demonstrates a pattern of clinician underestimation, particularly with regard to the potential for penetrating trauma and significant internal injury. It is hoped that this study will change the way that emergency physicians approach patients who have been shot with the police bean bag.

Author contributions: KRC and WM conceived the study. KRC and AS investigated ballistics and identified initial cases. DdB managed the data and drafted the manuscript. WM, DdB, and KRC contributed to its revision. WM, DdB, and KRC take responsibility for the paper as a whole.

REFERENCES

1. Kirschner RH. Police brutality in the USA. *Lancet*. 1997;350:1395.
2. Shank EB, Thein BK, Campbell D, et al. *A comparison of various less lethal projectiles* (MD Technical Report No.74-79). Aberdeen, MD: US Army Land Warfare Laboratory; 1974.
3. Sehgal A, Challoner K. The flexible baton TM-12: a case report involving a new police weapon. *J Emerg Med*. 1997;15:789-791.
4. Endicott J, Spitzer RL, Fleiss JL, et al. The Global Assessment Scale: a procedure for measuring overall severity of psychiatric disturbance. *Arch Gen Psychiatry*. 1976;33:766-771.
5. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed. Washington, DC: American Psychiatric Association; 1994.
6. Leach R, Hammond G, Stryker W. Anterior tibial compartment syndrome: acute and chronic. *J Bone Joint Surg Am*. 1967;3:451-462.
7. Brinton D. Model 2581 Supersock Bean Bag [memo]. Jamestown, PA: Combined Tactical Systems, Inc. April 11, 2000.
8. MK Ballistic Systems [product brochure]. *Flexible baton 12 less lethal ammunition: make it your first shot*. Hollister, CA: MK Ballistic Systems; 1997.
9. Cuadros JH. *A training manual for flexible baton selection and use*. Hollister, CA: MK Ballistic Systems; 1993.
10. Hamdorf R. *Nonlethal incapacitation*. Proceedings of the Asia Pacific Police Technology conference; September 5, 1991; Adelaide, South Australia.
11. Los Angeles Police Department, Commanding Officer of Training Division. *Protocols and procedures for bean bag shotgun deployment* [Human resources bureau training division memo to all commanding officers]. Los Angeles, CA: Los Angeles Police Department; 1996.